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Pate

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(54) **SENSOR MOUNTING ASSEMBLY FOR DRILL COLLAR STABILIZER**

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E21B 47/01 (2012.01)
E21B 17/10 (2006.01)

(52) **U.S. Cl.**

CPC ***E21B 47/01*** (2013.01); ***E21B 17/1014*** (2013.01)

(58) **Field of Classification Search**

CPC ... E21B 47/01; E21B 17/1078; E21B 47/082; E21B 47/00
USPC 175/50, 40, 45, 76, 325.1, 325.3; 166/254.2
See application file for complete search history.

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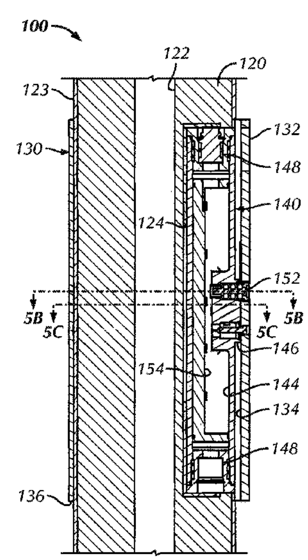
(57) **ABSTRACT**

A drill collar assembly allows a sensor to be mounted with the same standoff from a borehole wall independent of the size of stabilizer and borehole involved. A sensor component disposes in a receptacle in the drill collar, but does not affix in the receptacle. Instead, a stabilizer fits on the drill collar and covers the receptacle, and the sensor component mounts directly to the underside of the stabilizer so the component "floats" or "suspends" in the receptacle. The sensor component can mount at a stabilizer blade so the sensor can be positioned in closer proximity to the borehole wall to measure parameters of interest. Because the drill collar and sensor component can be used in different sized boreholes, different sized stabilizers may be positioned on the drill collar to account for the different sized boreholes while the sensor still has the same standoff.

50 Claims, 6 Drawing Sheets



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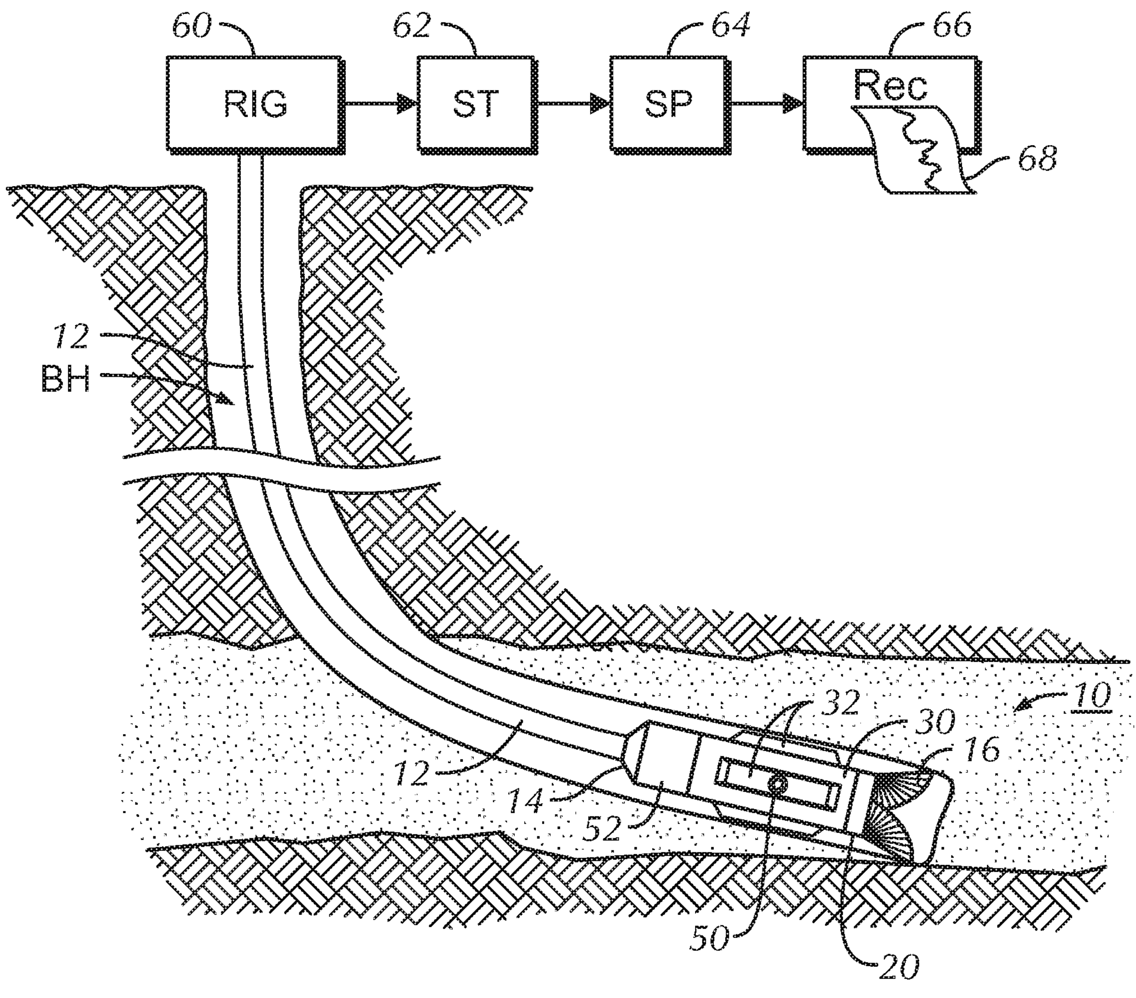

FIG. 1
(Prior Art)

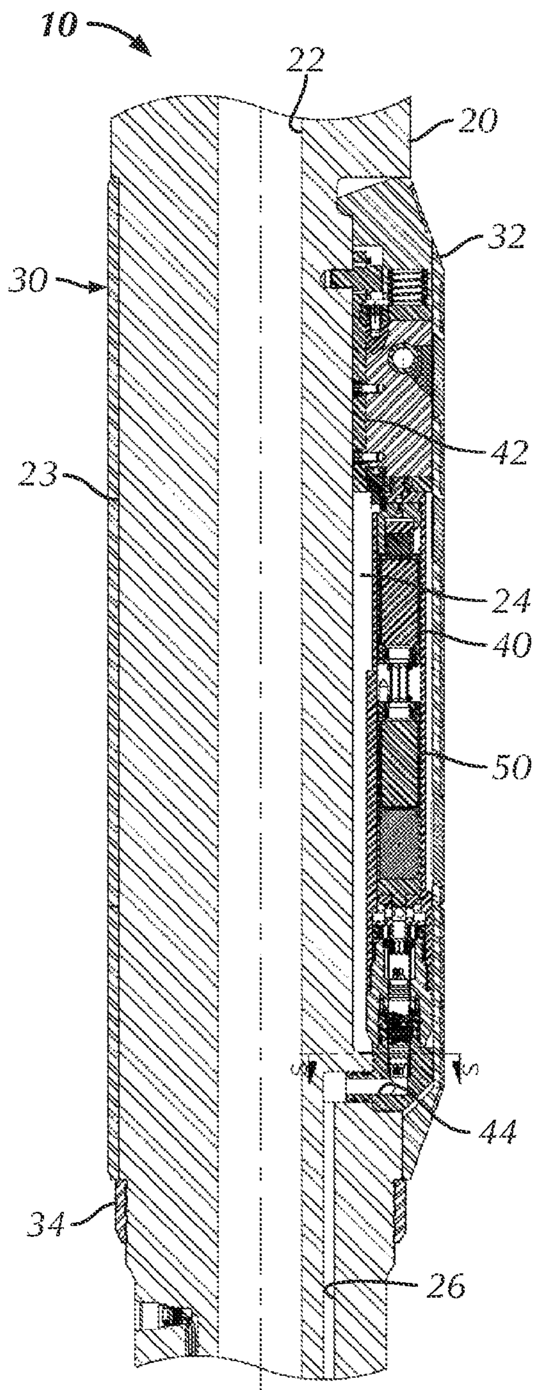

FIG. 2
(Prior Art)

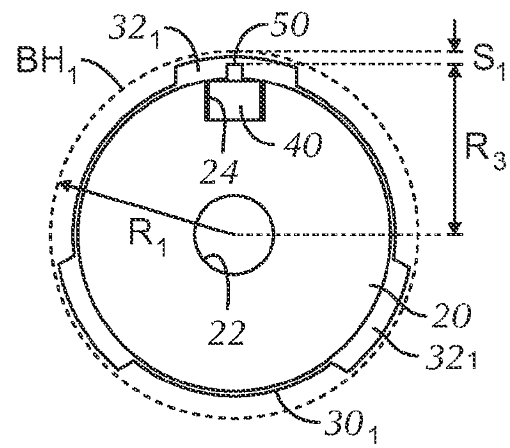

FIG. 3A
(Prior Art)

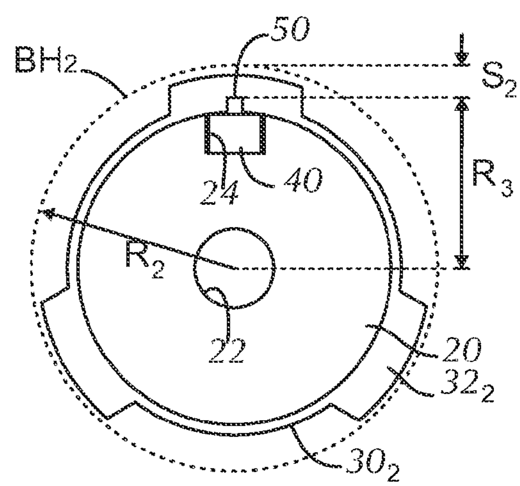

FIG. 3B
(Prior Art)

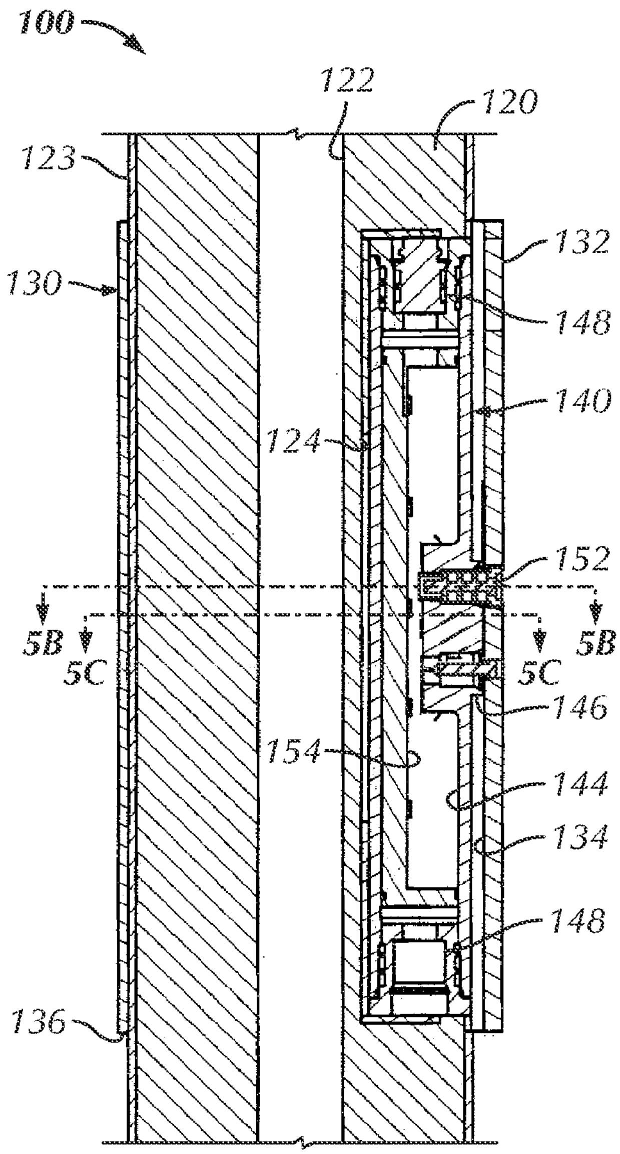

FIG. 4

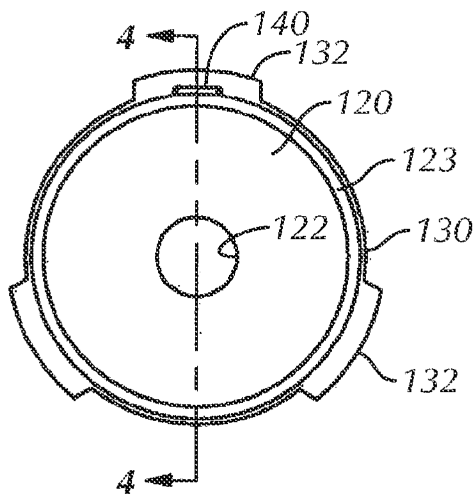

FIG. 5A

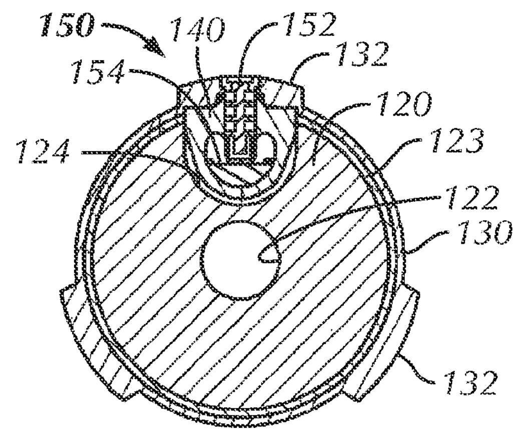

FIG. 5B

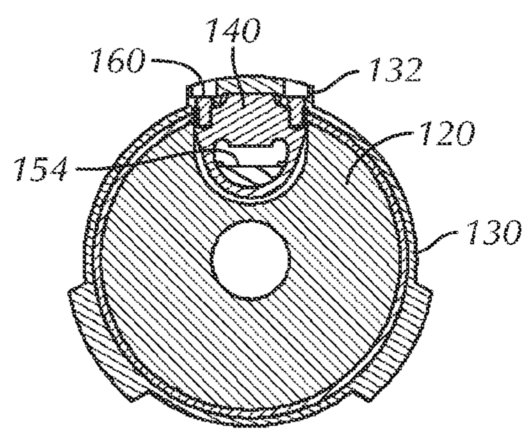

FIG. 5C

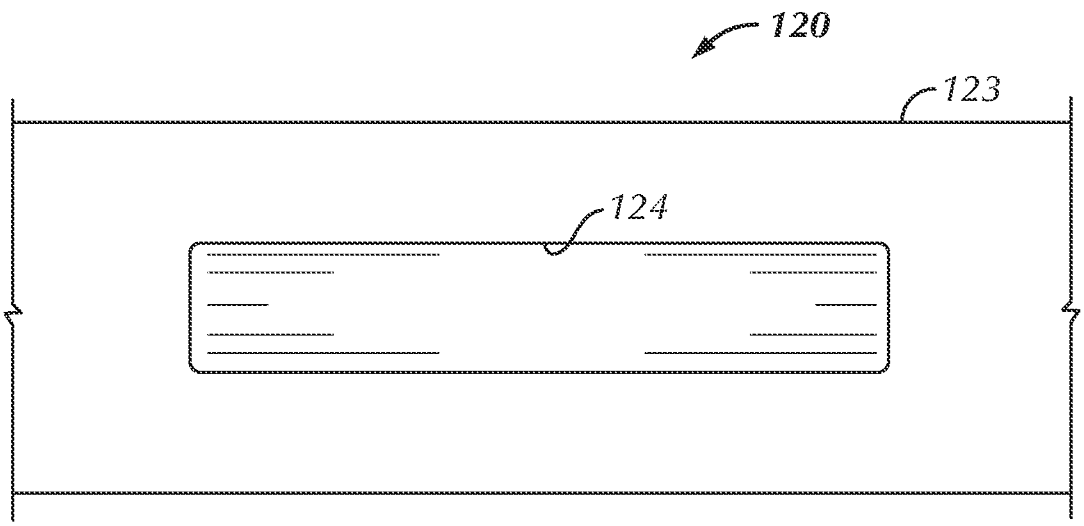

FIG. 6A

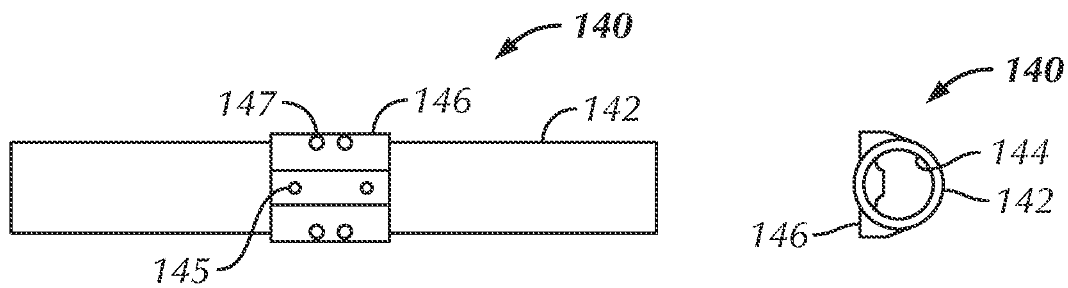

FIG. 6B-1

FIG. 6B-2

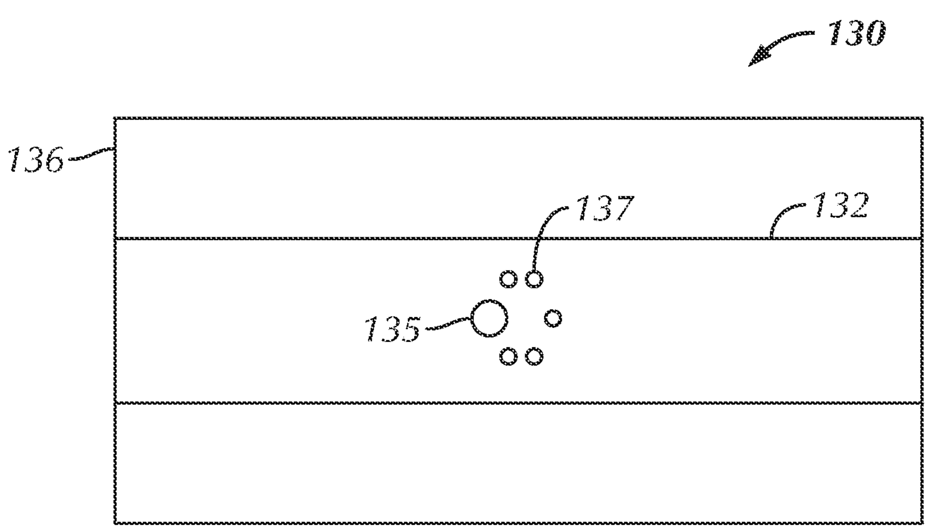

FIG. 6C

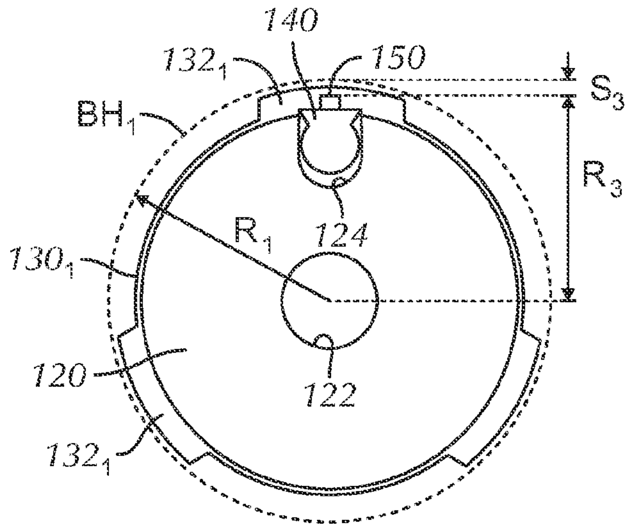

FIG. 7A

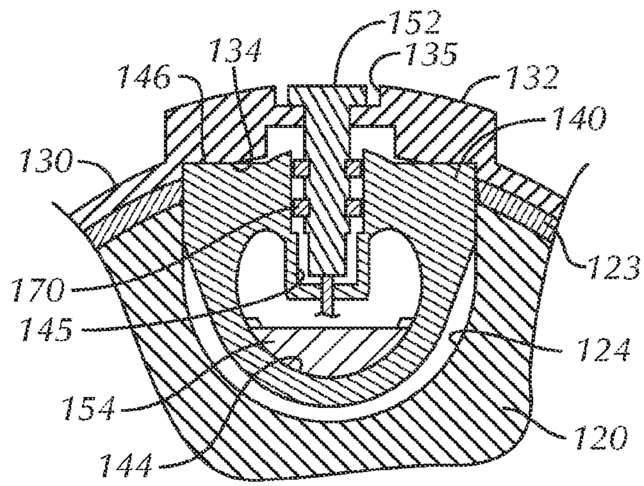

FIG. 8

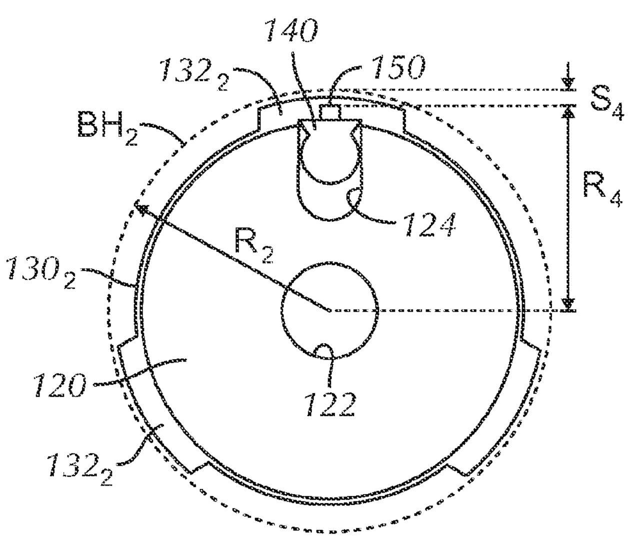

FIG. 7B

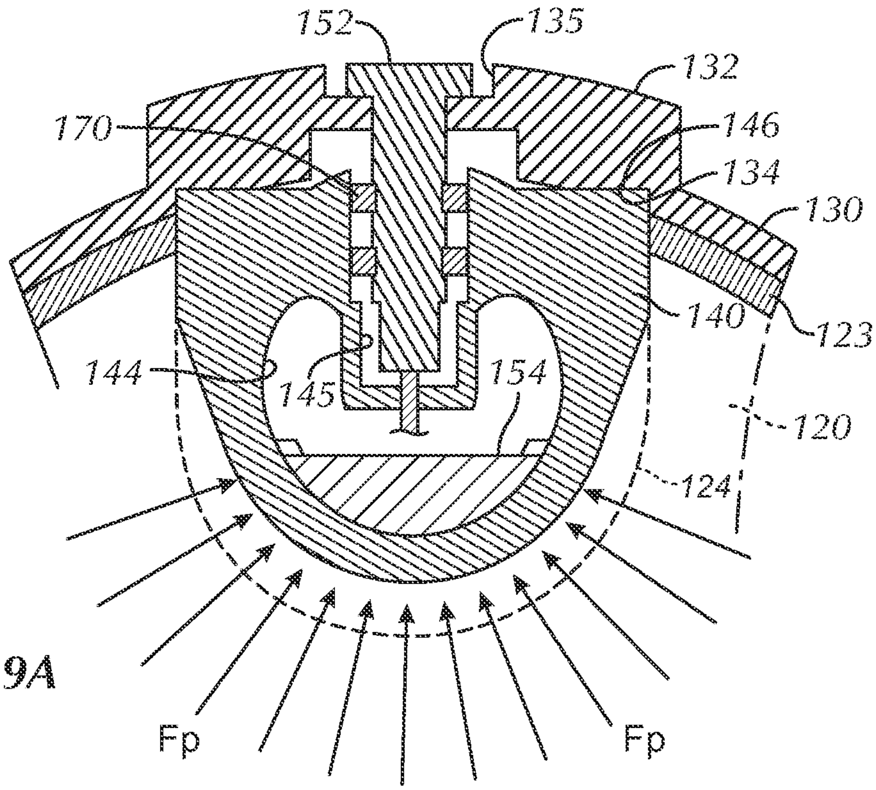
152
135
132
170
146
134
130
140
123
144
145
154
120
124
Fp
Fp

FIG. 9A

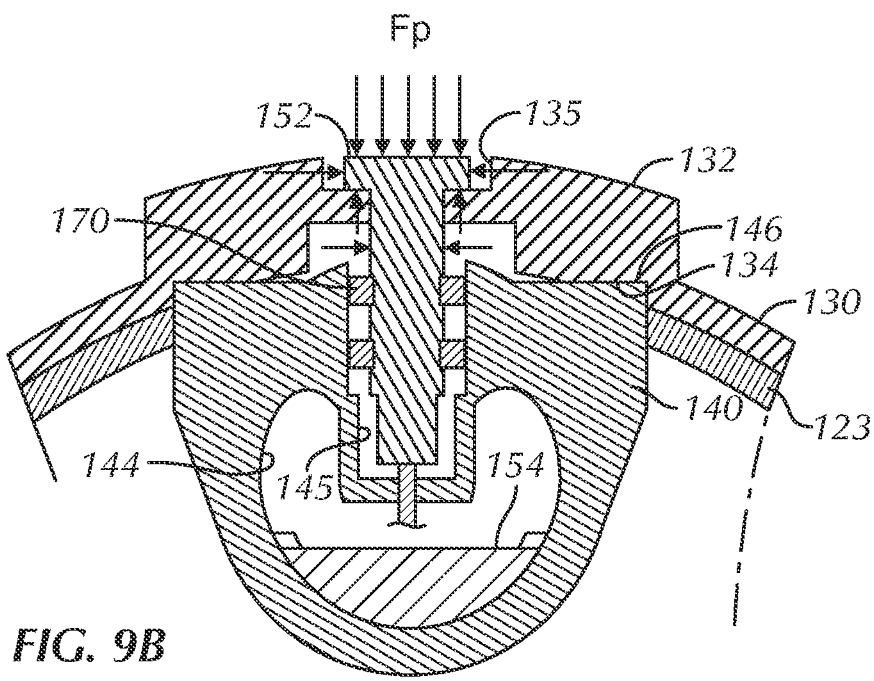
Fp
152
135
132
170
146
134
130
140
123
144
145
154

FIG. 9B

SENSOR MOUNTING ASSEMBLY FOR DRILL COLLAR STABILIZER

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims the benefit of U.S. Provisional Appl. No. 61/551,609, filed 26 Oct. 2011, which is incorporated herein by reference in its entirety.

BACKGROUND

FIG. **1** shows the general configuration of a drilling system in a Measurement-While-Drilling (MWD) or Logging-While-Drilling (LWD) environment. A downhole tool **10** disposes in a borehole BH and is operationally connected to a drill string **12** by a suitable connector **14**. At its lower end, the tool **10** has a drill bit **16**. Uphole, a rotary drilling rig **60** rotates the drill string **12**, the downhole tool **10**, and the drill bit **16** to drill the borehole BH. As will be appreciated, other types of borehole conveyance can be used for the downhole tool **10**.

The downhole tool **10** has a drill collar **20**, a borehole sensor **50**, and an electronics subsection **52**. The drill collar **20** has a stabilizer sleeve **30** disposed thereon, and the borehole sensor **50** is mounted at a stabilizer blade **32**. Depending on the desired parameters of interest, the borehole sensor **50** measures data in the borehole environs, and the electronics subsection **52** can process and store the data and can telemeter the data uphole for any of the various purposes associated with LWD/MWD.

A surface processor **64** cooperating with the electronic subsection **52** may handle the data and can perform additional mathematical operations associated with standard geological applications. Processed data can then be output to a recorder **66** for storage and optionally for output as a function of measured depth thereby forming an "image" or "log" **68** of one or more parameters of interest. All throughout operations, signals can be sent downhole to vary the direction of drilling or to vary the operation of the downhole tool **10**.

There are a few techniques for mounting a sensor on a downhole tool **10** for interaction with a borehole BH. Conventional wisdom in the art has been to either install the sensor externally on a drill collar or stabilizer or to particularly configure the sensor to install on the drill collar or stabilizer. Thus, one technique simply mounts a sensor with a plate on a portion of a drill collar. For example, U.S. Pat. No. 7,250,768 to Ritter et al. discloses a modular cross-over sub for a bottom hole drilling assembly having a stabilizer. Separate from the stabilizer, a resistivity sensor on a plate affixes to the outside of the sub where the sensor and measuring electronics are disposed.

Alternatively, a sensor can be directly part of a stabilizer. For example, U.S. Pat. Pub. No. 2009/0025982 discloses instrumentation devices disposed externally on a blade of a stabilizer using rings attached to the blade with screws or other attachment means.

Finally, a particularized package for a sensor can fit in a recess of a downhole tool and can have a stabilizer fit thereover. For example, U.S. Pat. No. 6,666,285 to Jones et al. discloses a drilling conduit having a cavity particularly sized to receive an instrument package. A portion of the package radially protrudes a distance, and an alignment channel in a stabilizer element is dimensioned to receive the protruding portion of the instrument package. For ease of manufacturing, the alignment channel extends the entire length of the stabilizer element.

As a particular example, FIG. **2** is a side cross-section of a portion of a downhole tool **10** having a sensor and stabilizer arrangement according to the prior art. The drill collar **20** is shown with its internal bore **22** for passage of drilling fluid. A sensor housing **40** fits inside a recess or pocket **24** formed on the outside surface **23** of the drill collar **20** and hard-mounts to the drill collar **20** using mounting components **42**. The sensor housing **40** has a sensor **50** (e.g., LWD downhole measurement equipment), and the hard mounting of the housing **40** provides stable positioning of the sensor **50** and helps protect the sensor **50** from damage.

The sensors used for LWD/MWD applications typically measure parameters of the formation traversed by the borehole or of the borehole itself. In typical applications, measurement accuracy is degraded by excessive and/or inconsistent standoff between the sensor and the surrounding borehole wall. To reduce standoff, the sensor **50** may actually be positioned in the drill collar's pocket **24** at a further radial distance than the drill collar's outer surface **23**. This allows the sensor **50** to position closer to the borehole wall. To help maintain the consistent standoff and to protect the sensor **50**, a stabilizer sleeve **30** is typically employed and is positioned directly on the drill collar's outer surface **23**. When the sleeve **30** is pushed into position on the outside of the drill collar **20**, one of the stabilizer blades **32** on the stabilizer sleeve **30** fits directly over the sensor housing **40**, and the stabilizer sleeve **30** can be retained using a shoulder on the drill collar **20** and a bushing **34** or other features.

Because the housing **40** is physically mounted to the collar **20**, the distance between the sensor **50** and the borehole wall will change if the diameter of the borehole BH to be drilled is changed and if the stabilizer sleeve's diameter is also changed accordingly. This impacts the ability to make consistent measurements with the sensor **50** when used in different configurations because the changes in distance from the borehole wall will attenuate the measurements made.

For example, FIGS. **3A-3B** are end views diagramming the prior art sensor and stabilizer arrangement for different sized boreholes BH_1 and BH_2. As can be seen, the radius R_1 of the first borehole BH_1 is smaller than the radius R_2 of the second borehole BH_2. As is common, the same sized drill collar **20** may be used to drill both of these boreholes BH_1 and BH_2, while other components of the drilling system are changed to create the different sized boreholes BH_1 and BH_2. To account for the difference in borehole size relative to the same sized drill collar **20**, different sized stabilizer sleeves $\mathbf{30}_1$ and $\mathbf{30}_2$ are used when drilling. For instance, the first stabilizer sleeve $\mathbf{30}_1$ for the smaller borehole BH_1 has lower profile stabilizer blades $\mathbf{32}_1$, while the other stabilizer sleeve $\mathbf{30}_2$ for the larger borehole BH_2 has higher profile stabilizer blades $\mathbf{32}_2$.

Yet, in both circumstances, the sensor housing **40** hard-mounted to the drill collar **20** keeps the sensor **50** at the same position on the drill collar **20**. As a result, the sensor **50** has a smaller standoff S_1 relative to the wall of the smaller borehole BH_1, but has a larger standoff S_2 relative to the wall of the larger borehole BH_2.

For measurement accuracy, the sensor **50** is typically calibrated electronically and with processing algorithms to operate best with a particular standoff from the borehole wall. Due to the different sized stabilizer sleeves $\mathbf{30}_1$ and $\mathbf{30}_2$ needed in some drilling applications as seen in FIGS. **3A-3B**, the standoff under which the sensor **50** measures can change. To obtain useful measurements, operators must therefore recalibrate the sensor **50** to operate with the different standoffs S_1 and S_2, or an entirely different sensor housing **40** may need to be used so the sensor **50** will have the calibrated standoff.

As always, changes or modifications made in drilling applications can increase costs, slow down drilling operations, engender unwanted errors, and the like. For these and other reasons, the subject matter of the present disclosure is directed to overcoming, or at least reducing the effects of, one or more of the problems set forth above.

SUMMARY

A sensor and stabilizer arrangement for a borehole drilling tool allows a sensor to be mounted with the same standoff from a borehole wall independent of the size of stabilizer, borehole, and collar involved. The drilling tool has a drilling body, such as a drill collar, defining a receptacle exposed in its outer surface. An electronic sensor component for an LWD/MWD-type sensor or detector disposes in the receptacle, but does not affix in the receptacle. Instead, a stabilizer fits over the drill collar and covers the receptacle and sensor component, and the sensor component mounts directly to the underside of the stabilizer. For example, fasteners affix in openings on the outside surface of the stabilizer and mount the sensor component directly to the underside of the stabilizer so that the electronic component "floats" or "suspends" in the receptacle. Preferably, the sensor component mounts directly to the stabilizer's underside at one of the stabilizer blades so a sensor element exposed on the outside of the stabilizer can be positioned in proximity to the borehole wall to measure parameters of interest.

The drill collar and sensor component can be used in different sized boreholes during drilling, and different sized stabilizer may be positioned on the drill collar to account for the different sized boreholes. Thus, the disclosed arrangement offers a modular system in which the same sensor component and drill collar can be used together and different sized stabilizers can be interchanged thereon depending on the borehole size. Because the same sized drill collar and sensor components may be used to drill larger or smaller sized boreholes, having the sensor component mounted directly underneath the stabilizer maintains the same standoff between the sensor and the borehole wall regardless of the borehole size being drilled. Thus, operators can use the same sensor components for different sized boreholes and do not need to reconfigure or recalibrate the sensor to operate with a different standoff in different sized boreholes.

The disclosed stabilizer and sensor arrangement is in contrast to the typical hard-mounting of sensor components to the drill collar in the prior art. Being coupled to the stabilizer, the sensor maintains a consistent standoff from the borehole wall, and the sensor can be calibrated to obtain the best measurements with this particular standoff. The disclosed arrangement can offer a number of benefits in the operation of a drilling tool having a sensor because the arrangement maintains a consistent distance between the borehole wall and any sensors, independent of tool body size, stabilizer size, or borehole size. As a result, there will be less measurement attenuation in comparison to the current collar mounted scheme.

The foregoing summary is not intended to summarize each potential embodiment or every aspect of the present disclosure.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** illustrates a drilling assembly having a sensor mounted on a stabilizer of a downhole tool.

FIG. **2** is a side cross-section of a downhole tool having a sensor and stabilizer arrangement according to the prior art.

FIGS. **3**A-**3**B are end views showing the prior art sensor and stabilizer arrangement for different sized boreholes.

FIG. **4** is a side cross-section showing a downhole tool having a sensor and stabilizer arrangement according to the present disclosure.

FIG. **5**A is an end view of the downhole tool of FIG. **4**.

FIGS. **5**B-**5**C are end-sections of the downhole tool of FIG. **4**.

FIG. **6**A is a plan view of a drill collar for the disclosed sensor and stabilizer arrangement.

FIG. **6B-1** is a plan view of a sensor housing for the disclosed sensor and stabilizer arrangement.

FIG. **6B-2** is an end view of the sensor housing of FIG. **6B-1**.

FIG. **6**C is a plan view of a stabilizer for the disclosed sensor and stabilizer arrangement.

FIGS. **7**A-**7**B are end views diagramming the disclosed sensor and stabilizer arrangement for different sized boreholes.

FIG. **8** is an end-section detailing the stabilizer, the sensor housing, and other components.

FIGS. **9**A-**9**B are end-sections showing pressure forces acting on the sensor housing and sensor element.

DETAILED DESCRIPTION

FIG. **4** is a side cross-section showing a downhole tool **100** having a sensor and stabilizer arrangement according to the present disclosure. The tool **100** can be used on a drilling assembly, such as discussed previously in FIG. **1**. The tool **100** includes a downhole tubular **120**, such as a drill collar or other drilling body. The drill collar **120** carries a sensor component, which includes a sensor housing **140** and sensor **150** for MWD/LWD applications in a borehole. As is customary, the drill collar **120** can have an internal bore **122** for passage of drilling fluid and can have an outside surface **123** with a protective sheathing.

The tool's sensor housing **140** disposes in a receptacle or pocket **124** formed on the outer surface **123** of the drill collar **120**. The sensor housing **140** holds the borehole sensor **150** beyond the collar's outer surface **123** so the sensor **150** can be positioned in closer proximity to a borehole wall (not shown) for measuring parameters of interest. As will be appreciated, the sensor **150** can be any LWD/MWD sensor, detector, or other device used in the art, including, but not limited to, a resistivity imager, a gamma sensor, an extendable formation testing sensor, a transducer, a transceiver, a receiver, a transmitter, acoustic element, etc. To provide strength and to reduce electrical interference, the sensor housing **140** can be made from a suitable alloy.

The drill collar **120** has a stabilizer **130** disposed thereon to stabilize the drill collar **120** during operation and to position the sensor **150** closer to the borehole wall. Although not shown, the stabilizer **130** can affix to the drill collar **120** using any of the common techniques known in the art. For example, the stabilizer **130** can be heat shrunk onto the collar **120**, and/or ends **136** of the stabilizer **130** can be affixed by welding, fasteners, or the like.

Rather than hard-mounting the sensor housing **140** to the drill collar **120** as in the prior art, the sensor housing **140** mounts directly to the underside or undersurface **134** of the stabilizer **130** and preferably mounts at one of the extended stabilizer blades **132**. By mounting directly to the undersurface **134**, the sensor housing **140** is essentially supported at its circumferential distance on the drill collar **120** independent of the receptacle **124**. Accordingly, the housing **140** "floats" or "suspends" in the drill collar's receptacle **124**. As shown in

FIG. **4**, for example, the sensor housing **140** is shown disposed in, but not mounted in, the sensor receptacle **124** of the drill collar **120**. A top surface **146** of the sensor housing **140** mounts directly to the undersurface **134** of the stabilizer **130** so that sensor openings in the housing **140** align with corresponding openings in the stabilizer **130**. If desired, support (i.e., shims, spacers, shock absorbers, etc.) can be used in the space between the sensor housing **140** and the receptacle **124**.

The sensor housing **140** has a central passage or compartment **144** in which electronic components **154** of the sensor **150** mount. Typically, the electronic components **154** include a circuit board, power supply, and other elements needed for operation of the sensor **150**. The internal components **154** can operatively couple to one or more external sensor elements **152** exposed on the surface of the stabilizer **150**, but this depends on the sensor **150** used as some sensors may not require such an exposed element **152**. The sensor element **152** is intended to interact with the borehole wall, annulus, etc. to obtain measurements of interest.

End caps **148** affix to open ends of the housing **140** to seal the housing's compartment **144** so the electronic components **154** can be protected from pressures and drilling fluid. These end caps **148** can have passages to communicate electric wiring, hydraulics, or the like between the sensor components **154** and other parts of the tool **100**, such as memory or telemetry components.

FIG. **5**A is an end view of the drill collar **120**, showing the arrangement of the stabilizer **130** and blades **132** about the collar's outer surface **123**. The end-section of FIG. **5**B shows the sensor housing **140** disposed in the collar's receptacle **124** and abutted against the undersurface **134** of the stabilizer **130** at one of the blades **132**. The sensor element **152** is shown exposed on the surface of the blade **132** and extending into the housing's compartment **144** where the sensor element **152** operatively couples to the electronic components **154**.

Finally, the end-section of FIG. **5**C shows the sensor housing **140** mounted directly to (i.e., directly attached or affixed to) the collar's undersurface **134** using fasteners **160**. Although one of the blades **132** has a sensor housing **140** and sensor **150** as detailed herein, one or more of the other blades **132** could also have such components. Moreover, although preferred, the sensor component (i.e., housing **140** and sensor **150**) need not be disposed at a blade, if any, on the stabilizer **130**.

With a general understanding of the stabilizer and sensor arrangement, assembly of the disclosed arrangement is discussed with reference to FIGS. **6**A through **6**C. As shown in the plan view of FIG. **6**A, the drill collar **120** has its receptacle **124** formed in its outer surface **123** using conventional techniques. Various channels or passages (not shown) may be defined in the collar **120** to communicate electronic wiring, hydraulics, and the like to any components to be held in the receptacle **124**. As noted herein, the sensor housing **140** does not mount to the drill collar **120** so fastening holes may not be present, although various alignment holes (not shown) may be provided in the receptacle's bottom surface to receive alignment pins or the like so the housing **140** can be aligned in the receptacle **124**.

The sensor housing **140** is a pressure housing, and as shown in FIGS. **6**B-**1** and **6**B-**2**, the housing **140** can have an elongated, cylindrical body **142**, although other shapes such as rectilinear shapes can be used. The body **142** defines the internal compartment **144** for electronics and has one or more mounting surfaces or platforms **146** with fastener holes **147**, alignment pin holes, and sensor holes **145** for aligning with holes in the stabilizer **130** as discussed below. Although alignment can be achieved in a number of ways between the components, alignment for the housing **140** is preferably accomplished using pins (not shown) between the sensor housing **140** and the stabilizer **130**.

As shown in FIG. **6**C and elsewhere, the stabilizer **130** is typically a cylindrical sleeve and has a number of outward extending blades **132**, ribs, arms, or other features that increase the outer dimension of the stabilizer **130**. The stabilizer **130** fits over the drill collar **120** and mounts thereon using techniques known in the art, such as heat shrinking, welding, bolting, and the like. The stabilizer **130** has a number of holes or openings defined in one of the blades **132** or elsewhere, including sensor openings **135** for portions of the sensor **150** to face the borehole environs. Other openings **137** are mounting pin holes to receive mounting bolts or fasteners (**160**) to hold the sensor housing **140** underneath the stabilizer **130**, as discussed previously.

During assembly, the sensor housing **140** is outfitted with the components and electronics of the sensor **150**, end caps **148**, etc. Assemblers then set the housing **140** temporarily in the collar's receptacle **124**. Assemblers then slide the stabilizer **130** shown in FIG. **6**C over the drill collar's outer surface **123** while the sensor housing **140** rests in the receptacle **124**. When properly positioned, assemblers then position fasteners **160** through openings **137** in the stabilizer **130** to affix to the fastener holes **147** on the housing's mounting surface **146**. As the fasteners are tightened, the sensor housing **140** "floats" or "suspends" in the collar's receptacle **124** and mounts directly to the underside of the stabilizer **130**. The sensor element **152** can then be installed as needed into the sensor openings **135** in the stabilizer **130** to connect with the electronic components **154** installed in the housing **140** underneath.

The advantages of the sensor and stabilizer arrangement of the present disclosure are best illustrated with reference to FIGS. **7**A-**7**B, which show the disclosed sensor and stabilizer arrangement for different sized boreholes. As can be seen, the radius R_1 of a first borehole BH_1 (FIG. **7**A) is smaller than the radius R_2 of a second borehole BH_2 (FIG. **7**B). Again, the same sized drill collar **120** may be used in some circumstances to drill both of these boreholes BH_1 and BH_2 because other components of the drilling assembly may be changed to create the different sized boreholes BH_1 and BH_2.

To account for the difference in borehole size relative to the same sized drill collar **120**, different sized stabilizers **130**$_1$ and **130**$_2$ are used when drilling. The first stabilizer **130**$_1$ (FIG. **7**A) for the smaller borehole BH_1 has lower profile stabilizer blades **132**$_1$, while the other stabilizer **130**$_2$ (FIG. **7**B) for the larger borehole BH_2 has higher profile stabilizer blades **132**$_2$.

Yet, in both circumstances, the sensor housing **140** mounted to the undersurface **134** of the stabilizer **130** keeps the sensor **150** at similar standoffs S_3 and S_4 from the borehole wall. The similar standoffs S_3 and S_4 are preferably the same, although they may vary to some degree dependent on the sensitivity and calibration of the sensor **150**. Having the similar standoffs S_3 and S_4 is possible because the sensor housing **140** "floats" or "suspends" in the collar's receptacle **124** as noted above and sits at different radii R_3 and R_4, respectively, for the different sized boreholes BH_1 and BH_2.

As noted previously, the sensor **150** is calibrated electronically with processing algorithms to operate best with a particular standoff from the borehole wall. Using the disclosed arrangement, the particular standoff S for the sensor **150** can be maintained despite the different sized stabilizers **130**$_1$ and **130**$_2$ needed in some drilling applications. Accordingly, operators do not need to recalibrate the sensor **150** to operate with a different standoff and do not need to use an entirely different sensor as required in the prior art. Thus, the disclosed arrangement offers a modular system in which the same component, including sensor **150** and housing **140**, and the same drill collar **120** can be used together and in which different sized stabilizers $\mathbf{130}_1$ and $\mathbf{130}_2$ can be interchanged on the drill collar **120** depending on the borehole size.

In addition to the above, there are other advantages of the disclosed sensor and stabilizer arrangement. FIG. **8** shows a detailed end-section of the sensor housing **140** mounted on the underside **134** of the stabilizer **130**. As noted before, the sensor housing **140** is disposed in the collar's receptacle **124**, and the housing's mounting surface **146** is abutted against the undersurface **134** of the stabilizer **130** at one of the blades **132**.

The sensor element **152** is installed in the sensor opening **135** of the blade **132** and extends down into the sensor opening **145** in the sensor housing **140**. Various features, such as fasteners, threads, bushings, welds, etc. are not shown, but can be used to retain the sensor component **150** in these openings **135** and **145**. In addition to (or as an alternative to) such features, one or more sealing members **170** can be disposed between the interface of the sensor component **150** and the housing's opening **145**. Thus, the sensor element **152** is exposed on the surface of the blade **132** and extends into the housing's sealed compartment **144** where the element **152** operatively couples to the electronic components **154**.

When the drill collar **120** is deployed downhole in a borehole, fluid pressure F_p from the borehole as shown in FIG. **9**A may enter inside the drill collar's sensor receptacle **124**, depending on the sealing used. In turn, the fluid pressure F_p in the receptacle **124** acts against the surfaces of the housing **140**, and the net force of this fluid pressure F_p preferably forces the housing's mounting surface **146** against the undersurface **134** of the stabilizer **130**. Overall, the force of this fluid pressure F_p can help hold the sensor housing **140** in place on the stabilizer's undersurface **134**.

As shown in FIG. **9**B, fluid pressure F_p in the borehole annulus also acts against the surfaces of the sensor element **152** outside the sealing members **170** used. The net force of the fluid pressure F_p preferably tends to hold the sensor element **152** in the stabilizer blade **132** and housing **140**. As noted previously, the interior compartment **144** of the housing **140** is preferably fluidly isolated from the borehole so the electronic components **154** can be protected. The sealing members **170** used in the opening **145** help isolate the components **154** from fluid and help to keep the housing's interior compartment **144** at a lower pressure (e.g., atmospheric) than the borehole annulus. Advantageously, this difference in pressure between the upper and lower ends of the sensor element **152** tends to further retain the element **152** in the openings **135** and **145** of the blade **132** and housing **140**.

The foregoing description of preferred and other embodiments is not intended to limit or restrict the scope or applicability of the inventive concepts conceived of by the Applicants. It will be appreciated with the benefit of the present disclosure that features described above in accordance with any embodiment or aspect of the disclosed subject matter can be utilized, either alone or in combination, with any other described feature, in any other embodiment or aspect of the disclosed subject matter.

In exchange for disclosing the inventive concepts contained herein, the Applicants desire all patent rights afforded by the appended claims. Therefore, it is intended that the appended claims include all modifications and alterations to the full extent that they come within the scope of the following claims or the equivalents thereof.

What is claimed is:

1. A borehole drilling tool, comprising:

a drilling body having an outer surface and defining a receptacle exposed in the outer surface;

a first stabilizer having a first underside, the first stabilizer disposed on the outer surface of the drilling body and covering the receptacle; and

a sensor component for measuring in the borehole, the sensor component disposed in the receptacle and mounted with a mounting surface thereof directly affixed to the first underside of the first stabilizer.

2. The tool of claim **1**, wherein the drilling body comprises a drill collar for a drillstring.

3. The tool of claim **1**, wherein the first stabilizer comprises a cylindrical sleeve fitting around the outer surface of the drilling body.

4. The tool of claim **1**, wherein one or more fasteners dispose in openings in a topside of the first stabilizer and affix the sensor component to the first underside of the first stabilizer.

5. The tool of claim **1**, wherein the receptacle is larger than the sensor component such that the sensor component suspends in the receptacle.

6. The tool of claim **1**, wherein the first stabilizer comprises at least one blade extending outward therefrom, the sensor component being mounted directly to the first underside of the first stabilizer at the at least one blade.

7. The tool of claim **1**, wherein the sensor component has a first standoff from a wall of a first sized borehole.

8. The tool of claim **7**, further comprising a second stabilizer having a different size than the first stabilizer and having a second underside, the second stabilizer being interchangeably disposed on the outer surface of the drilling body instead of the first stabilizer and covering the receptacle, the sensor component mounting with the mounting surface thereof directly affixed to the second underside of the second stabilizer and having a second standoff from a wall of a second sized borehole.

9. The tool of claim **7**, wherein the second sized borehole is larger or smaller than the first sized borehole, and wherein the second standoff is approximately equal to the first standoff.

10. The tool of claim **1**, wherein the sensor component comprises a housing mounted directly to the first underside of the first stabilizer and housing electronics therein.

11. The tool of claim **10**, wherein the housing comprises at least one end cap disposed thereon and enclosing the electronics housed therein.

12. The tool of claim **10**, wherein the housing comprises:

the mounting surface disposed against the first underside; and

a surrounding surface at least partially exposed in the receptacle,

wherein fluid pressure of the borehole in the receptacle acts against the surrounding surface of the housing and forces the mounting surface against the first underside.

13. The tool of claim **1**, wherein the sensor component comprises a sensor element exposed in an opening on a topside of the first stabilizer.

14. The tool of claim **13**, wherein the sensor element comprises one or more seals sealing the sensor element in the sensor component and isolating a first fluid pressure of the borehole from a second fluid pressure in the sensor component.

15. The tool of claim **14**, wherein a pressure differential between the first and second fluid pressures forces the sensor element into the sensor component.

16. A modular borehole drilling tool, comprising:

a drilling body having an outer surface and defining a receptacle exposed in the outer surface;

a sensor component disposing in the receptacle; and

at least two stabilizers having different sizes for use in different sized boreholes, each of the at least two stabilizers interchangeably disposing on the outer surface of the drilling body and covering the receptacle;

wherein the sensor component mounts directly to an underside of either of the at least two stabilizers when disposed on the drilling body such that the sensor component suspends in the receptacle, and

wherein the sensor component mounted directly to either of the at least two stabilizers has a same standoff distance to walls of the different sized boreholes when disposed relative thereto.

17. The tool of claim 16, wherein the drilling body comprises a drill collar for a drillstring.

18. The tool of claim 16, wherein the at least two stabilizers each comprises a cylindrical sleeve fitting around the outer surface of the drilling body.

19. The tool of claim 16, wherein one or more fasteners dispose in openings in a topside of the at least two stabilizers and affix the sensor component to the underside.

20. The tool of claim 16, wherein the receptacle is larger than the sensor component.

21. The tool of claim 16, wherein the at least two stabilizers each comprises at least one blade extending outward therefrom, the sensor component being mounted directly to the underside of the at least two stabilizers at the at least one blade.

22. The tool of claim 16, wherein the sensor component comprises a housing being mounted directly to the underside of the at least two stabilizers and housing electronics therein.

23. The tool of claim 22, wherein the housing comprises at least one end cap disposed thereon and enclosing the electronics housed therein.

24. The tool of claim 22, wherein the housing comprises:

a mounting surface disposed against the underside; and

a surrounding surface at least partially exposed in the receptacle,

wherein fluid pressure of the borehole in the receptacle acts against the surrounding surface of the housing and forces the mounting surface against the underside.

25. The tool of claim 16, wherein the sensor component comprises a sensor element exposed in an opening on a topside of the at least two stabilizers.

26. The tool of claim 25, wherein the sensor element comprises one or more seals sealing the sensor element in the sensor component and isolating a first fluid pressure of the borehole from a second fluid pressure in the sensor component.

27. The tool of claim 26, wherein a pressure differential between the first and second fluid pressures forces the sensor element into the sensor component.

28. A borehole drilling tool assembly method, comprising:

configuring a borehole sensor component for operation with a standoff from a wall of a borehole;

disposing the borehole sensor component in a receptacle defined in an outside surface of a drilling body;

selecting one of a plurality of stabilizers configured for a borehole size to be drilled with the drilling body, each of the stabilizers configured for a different sized borehole to be drilled with the drilling body;

disposing the selected stabilizer on the drilling body over the receptacle and the borehole sensor component; and

mounting the borehole sensor component with a mounting surface thereof directly affixed to an underside of the selected stabilizer.

29. The method of claim 28, wherein the drilling body comprises a drill collar for a drillstring, and wherein disposing the selected stabilizer on the drilling body over the receptacle and the borehole sensor component comprises fitting a cylindrical sleeve of the selected stabilizer around the outside surface of the drill collar.

30. The method of claim 28, wherein mounting the borehole sensor component with the mounting surface thereof directly affixed to the underside of the selected stabilizer comprises disposing one or more fasteners in openings in a topside of the selected stabilizer and affixing the sensor component to the underside of the selected stabilizer.

31. The method of claim 28, wherein mounting the borehole sensor component comprises suspending the borehole sensor component in the receptacle.

32. The method of claim 28, wherein the selected stabilizer comprises at least one blade extending outward therefrom, and wherein mounting the borehole sensor component comprises mounting the borehole sensor component at the at least one blade.

33. The method of claim 28, wherein the plurality of stabilizers comprise at least two stabilizers for at least two different sized boreholes; wherein selecting and disposing one of the plurality of stabilizers comprises interchangeably disposing the selected stabilizer on the outer surface of the drilling body; and wherein mounting the borehole sensor component comprises mounting the borehole sensor component to have a same standoff from a wall of the at least two different sized boreholes.

34. The method of claim 28, wherein mounting the borehole sensor component with the mounting surface thereof directly affixed to the underside of the selected stabilizer comprises:

disposing the mounting surface against the underside; and

at least partially exposing a surrounding surface of the borehole sensor component in the receptacle,

wherein fluid pressure of the borehole in the receptacle acts against the surrounding surface of the housing and forces the mounting surface against the first underside.

35. The method of claim 28,

wherein mounting the borehole sensor component comprises exposing a sensor element in an opening on a topside of the selected stabilizer; and

wherein the method further comprising isolating a first fluid pressure of the borehole from a second fluid pressure in the sensor component by sealing the sensor element in the sensor component;

wherein a pressure differential between the first and second fluid pressures forces the sensor element into the sensor component.

36. A borehole drilling tool, comprising:

a drilling body having an outer surface and defining a receptacle exposed in the outer surface;

at least one stabilizer having an underside, the at least one stabilizer disposed on the outer surface of the drilling body and covering the receptacle; and

a sensor component for measuring in the borehole, the sensor component disposed in the receptacle and comprising a housing mounted directly to the underside of the at least one stabilizer, the housing comprising a mounting surface disposed against the underside and comprising a surrounding surface at least partially exposed in the receptacle, wherein fluid pressure of the borehole in the receptacle acts against the surrounding surface of the housing and forces the mounting surface against the underside.

37. The tool of claim **36**, wherein the drilling body comprises a drill collar for a drillstring; and wherein the at least one stabilizer comprises a cylindrical sleeve fitting around the outer surface of the drilling body.

38. The tool of claim **36**, wherein one or more fasteners dispose in openings in a topside of the at least one stabilizer and affix the sensor component to the underside of the at least one stabilizer.

39. The tool of claim **36**, wherein the at least one stabilizer comprises at least one blade extending outward therefrom, the sensor component being mounted directly to the underside of the at least one stabilizer at the at least one blade.

40. The tool of claim **36**, wherein the at least one stabilizer comprises first and second stabilizers, wherein the sensor component mounted to the first stabilizer has a first standoff from a wall of a first sized borehole; and wherein the second stabilizer has a different size than the first stabilizer, the second stabilizer being interchangeably disposed on the outer surface of the drilling body instead of the first stabilizer and covering the receptacle, the sensor component mounting directly to the underside of the second stabilizer and having a second standoff from a wall of a second sized borehole.

41. The tool of claim **40**, wherein the second sized borehole is larger or smaller than the first sized borehole, and wherein the second standoff is approximately equal to the first standoff.

42. The tool of claim **36**, wherein the sensor component comprises a sensor element exposed in an opening on a topside of the at least one stabilizer; wherein the sensor element comprises one or more seals sealing the sensor element in the sensor component and isolating a first fluid pressure of the borehole from a second fluid pressure in the sensor component; and wherein a pressure differential between the first and second fluid pressures forces the sensor element into the sensor component.

43. The tool of claim **36**, wherein the at least one stabilizer comprises at least two stabilizers having different sizes for use in different sized boreholes, each of the at least two stabilizers interchangeably disposing on the outer surface of the drilling body and covering the receptacle, the housing mounting directly to the underside of either of the at least two stabilizers when disposed on the drilling body; and wherein the sensor component mounted directly to either of the at least two stabilizers has a same standoff distance to walls of the different sized boreholes when disposed relative thereto.

44. A borehole drilling tool, comprising:

a drilling body having an outer surface and defining a receptacle exposed in the outer surface;

at least one stabilizer having an underside, the at least one stabilizer disposed on the outer surface of the drilling body and covering the receptacle; and

a sensor component for measuring in the borehole, the sensor component disposed in the receptacle and mounted directly to the underside of the at least one stabilizer, the sensor component comprising a sensor element exposed in an opening on a topside of the first stabilizer, the sensor element comprising one or more seals sealing the sensor element in the sensor component and isolating a first fluid pressure of the borehole from a second fluid pressure in the sensor component, wherein a pressure differential between the first and second fluid pressures forces the sensor element into the sensor component.

45. The tool of claim **44**, wherein the drilling body comprises a drill collar for a drillstring; and wherein the at least one stabilizer comprises a cylindrical sleeve fitting around the outer surface of the drilling body.

46. The tool of claim **44**, wherein one or more fasteners dispose in openings in a topside of the at least one stabilizer and affix the sensor component to the underside of the at least one stabilizer.

47. The tool of claim **44**, wherein the at least one stabilizer comprises at least one blade extending outward therefrom, the sensor component being mounted directly to the underside of the at least one stabilizer at the at least one blade.

48. The tool of claim **44**, wherein the at least one stabilizer comprises first and second stabilizers; wherein the sensor component mounted to the first stabilizer has a first standoff from a wall of a first sized borehole; and wherein the second stabilizer has a different size than the first stabilizer, the second stabilizer being interchangeably disposed on the outer surface of the drilling body instead of the first stabilizer and covering the receptacle, the sensor component mounting directly to the underside of the second stabilizer and having a second standoff from a wall of a second sized borehole.

49. The tool of claim **48**, wherein the second sized borehole is larger or smaller than the first sized borehole; and wherein the second standoff is approximately equal to the first standoff.

50. The tool of claim **44**, wherein the at least one stabilizer comprises at least two stabilizers having different sizes for use in different sized boreholes, each of the at least two stabilizers interchangeably disposing on the outer surface of the drilling body and covering the receptacle, the sensor component mounting directly to the underside of either of the at least two stabilizers when disposed on the drilling body and having a same standoff distance to walls of the different sized boreholes when disposed relative thereto.

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